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DEPARTMENT OF THE INTERIOR  
U.S. GEOLOGICAL SURVEY

1986 GLIMPCE Seismic Reflection Survey

Stacked Data

by

W.F. Agena<sup>1</sup>, M.W.Lee<sup>1</sup>, D.R. Hutchinson<sup>2</sup>, J.C. Behrendt<sup>1</sup>,  
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U.S. Geological Survey

Open-File Report 88-386

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5. Line G (Lake Superior).....	in pocket
6. Line H (Lake Michigan).....	in pocket
7. Line I (Lake Huron).....	in pocket
8. Line J (Lake Huron).....	in pocket

## **1986 GLIMPCE Seismic Reflection Survey Stacked Data**

**W.F. Agena, M.W. Lee, D.R. Hutchinson, J.C. Behrendt,  
W.F. Cannon, and A.G. Green**

### **ABSTRACT**

During August and September of 1986, 1370 km of deep crustal marine multichannel seismic reflection data were collected in the Great Lakes region as part of the Great Lakes International Multidisciplinary Program on Crustal Evolution (GLIMPCE). The energy source was a 127.5-liter (7,780 in<sup>3</sup>) tuned airgun array, and 20 seconds of data were recorded with a 3 km streamer composed of 120 channels. The primary purpose of the survey was to better understand the deep structure and tectonics of the midcontinental rift system (MRS) and the Grenville tectonic province. The stacked seismic time sections are presented here at a scale of about 1:200000 (5 km/in) yielding no vertical exaggeration for an assumed crustal velocity of 6 km/s.

### **INTRODUCTION**

Multichannel seismic data over the Great Lakes were acquired by Geophoto Services, Ltd., a Canadian subsidiary of Geophysical Services Inc., under contract to the U.S. Geological Survey (USGS) and the Geological Survey of Canada (GSC) as part of the Great Lakes International Multidisciplinary Program on Crustal Evolution (GLIMPCE). Approximately 1370 km of seismic reflection data were acquired during August and September 1986. Shotpoint locations for each line are shown in figure 1. Seismic lines A, B, C, F and G (a total of 655 km) were located in Lake Superior, line H (284 km) in Lake Michigan, and lines I and J (431 km) in Lake Huron. This seismic survey was designed to resolve the deep crustal structure of the Keweenawan Rift (lines A,C,F,G and H), and the Hemlo and Michipicoten Granite/Greenstone Belts (line B), the Grenville Front (line J), the deformed Huronian continental margin (line I) and the Penokean Orogen and Niagara Fault (line H) (Green and others, 1987). Figure 2 is a generalized geologic map of the study area. This report presents a brief summary of the data processing and displays of the stacked seismic data. Other reports give details of the acquisition and processing parameters (Lee and others, 1988) and migration parameters (Milkereit and others, 1988). Preliminary interpretations exist for the deep structure (Behrendt and others, 1988a, 1988b), for the Keweenawan Rift (Cannon and others, 1988) and for the Grenville Front (Green and others, 1988).

### **DATA PROCESSING AND DISPLAYS**

Data from the GLIMPCE seismic reflection lines were acquired using a 3 km long streamer with 120 recording channels spaced at intervals of 25 meters. The seismic energy source was a tuned array of 60 airguns with a total volume of 127.5 liters (7780 in<sup>3</sup>). Details of the acquisition parameters are given on a line by line basis on the side labels of plates 1-8.

All of the data were stacked and plotted for interpretation at the USGS seismic data processing center in Denver, Colorado. The primary goal of the seismic data processing was to image the deeper part of the sections (>5 seconds). Processing that could enhance the shallow section was not attempted.

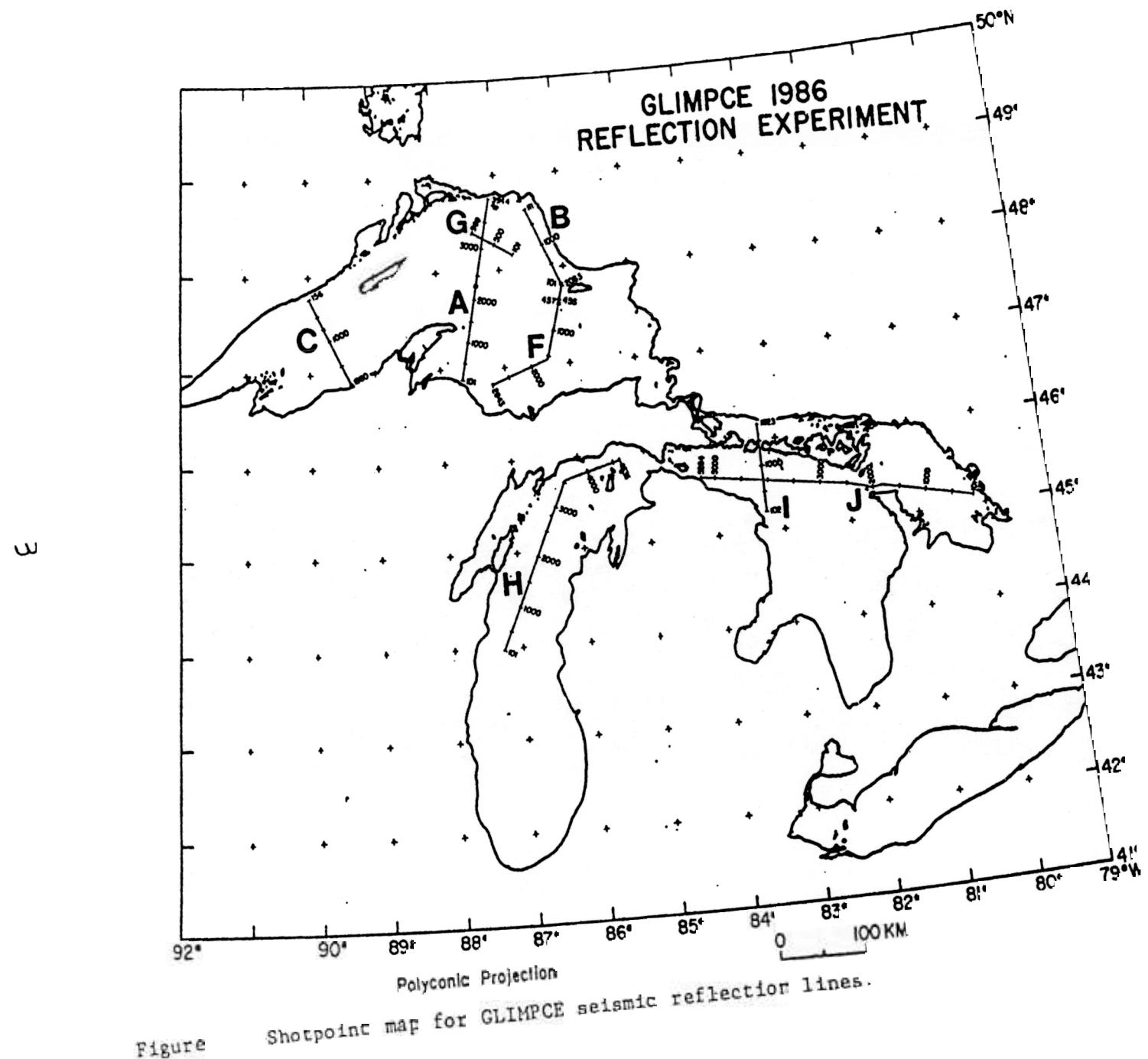
Processing was performed on a VAX 11/780 configured with 8 megabytes of memory (RAM), and 2 Floating Point Systems array processors, and DISCO seismic data processing software from COGNISEIS (formerly DIGICON). The processing sequence used is shown in figure 3. To improve the displays of the stacked data, a two-dimensional, smoothing filter and amplitude modulation were used. A 3 trace by 3 time sample, operator was used for the two-dimensional smoothing. To modulate the amplitudes, the input traces were multiplied by their amplitude envelopes raised to the power of 1.2 (Lee and others, 1988). These were especially effective in improving the presentation of deep reflections from 10 to 14 seconds. After completion of the processing, the final unmodulated, stacked data were output to magnetic tape in SEG-Y format and were shipped to the seismic processing center of the Lithosphere and Canadian Shield division of the GSC in Ottawa, Canada for the migration of the data.

To facilitate the handling of the final stacked sections, the data were summed 4 to 1, thus creating a consistent 50 meter common mid-point (CMP) interval for all final displays. The final seismic time sections (plates 1 - 8) are displayed at a horizontal scale of 100 traces per inch, approximately 1:200,000 if an interval velocity of 6 km/sec is assumed.

Results from this phase of the GLIMPCE seismic reflection data processing are presented to complement the results of the frequency-wavenumber (F-K) migrated data released by Milkereit and others (1988) and for use as the basis for independent interpretations and future reprocessing efforts. These data, together with other geological and geophysical data, may allow more accurate interpretation of this complex data set.

#### REFERENCES

- Behrendt, J.C., Green, A.G., Cannon, W.F., Hutchinson, D.R., Lee, M.W., Milkereit, B., Agena, W.F., and Spencer, C., 1988a, Results form GLIMPCE deep seismic reflection profiles over the mid-continent rift system: *Geology*, in press.
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- Green, A.G., Milkereit, B., Davidson, A., Spencer, C., Hoffman, P., Hutchinson, D.R., Cannon, W.F., Lee, M.W., Agena, W.F., Behrendt, J.C., 1988, Crustal structure of the Grenville front: Submitted to *Geology*.
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- Milkereit, B., Green, A.G., Morel, P., Lee, M.W., Agena, W.F., 1988, 1986 Great Lakes seismic reflection survey - Migrated data: Geological Survey of Canada Open-file No. 1592.



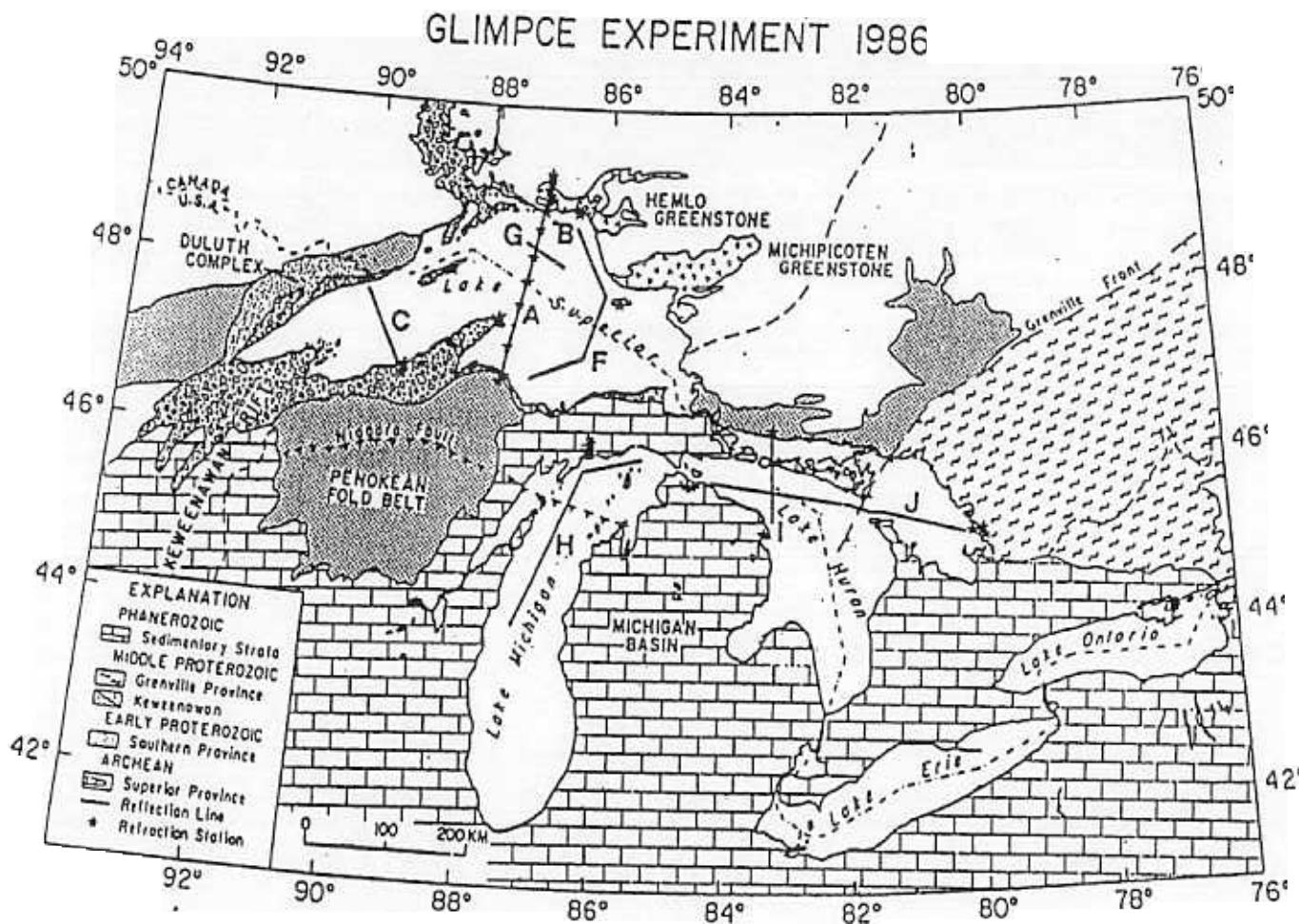


Figure 2.--Location of GLIMPCE seismic reflection lines in relation to geologic features

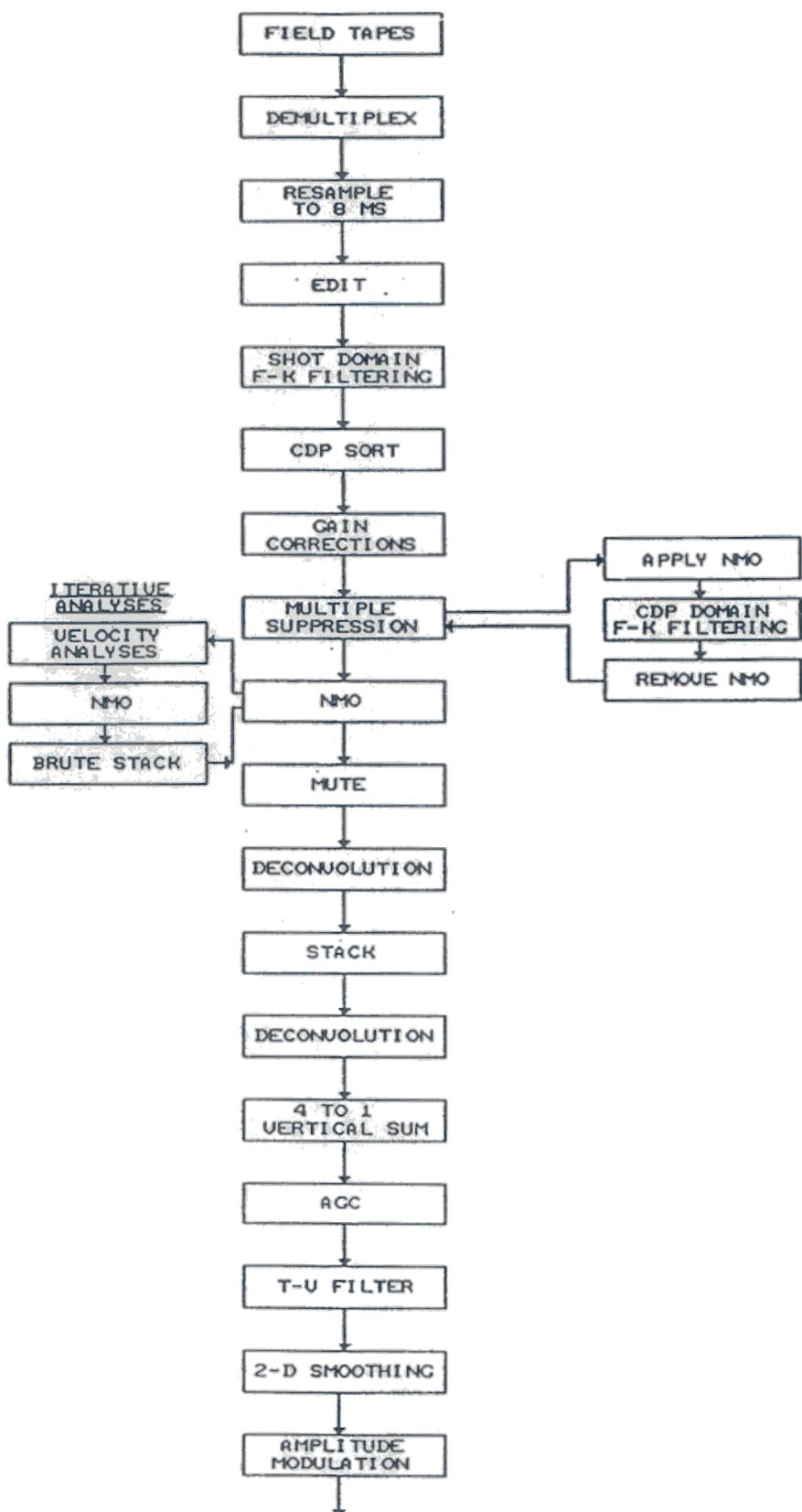


Figure 3.--Data processing sequence for the GLIMPCE seismic reflection data.



GLIMPCE  
1986

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LAKE SUPERIOR  
LINE: B  
FINAL STACK

SOUTHEAST

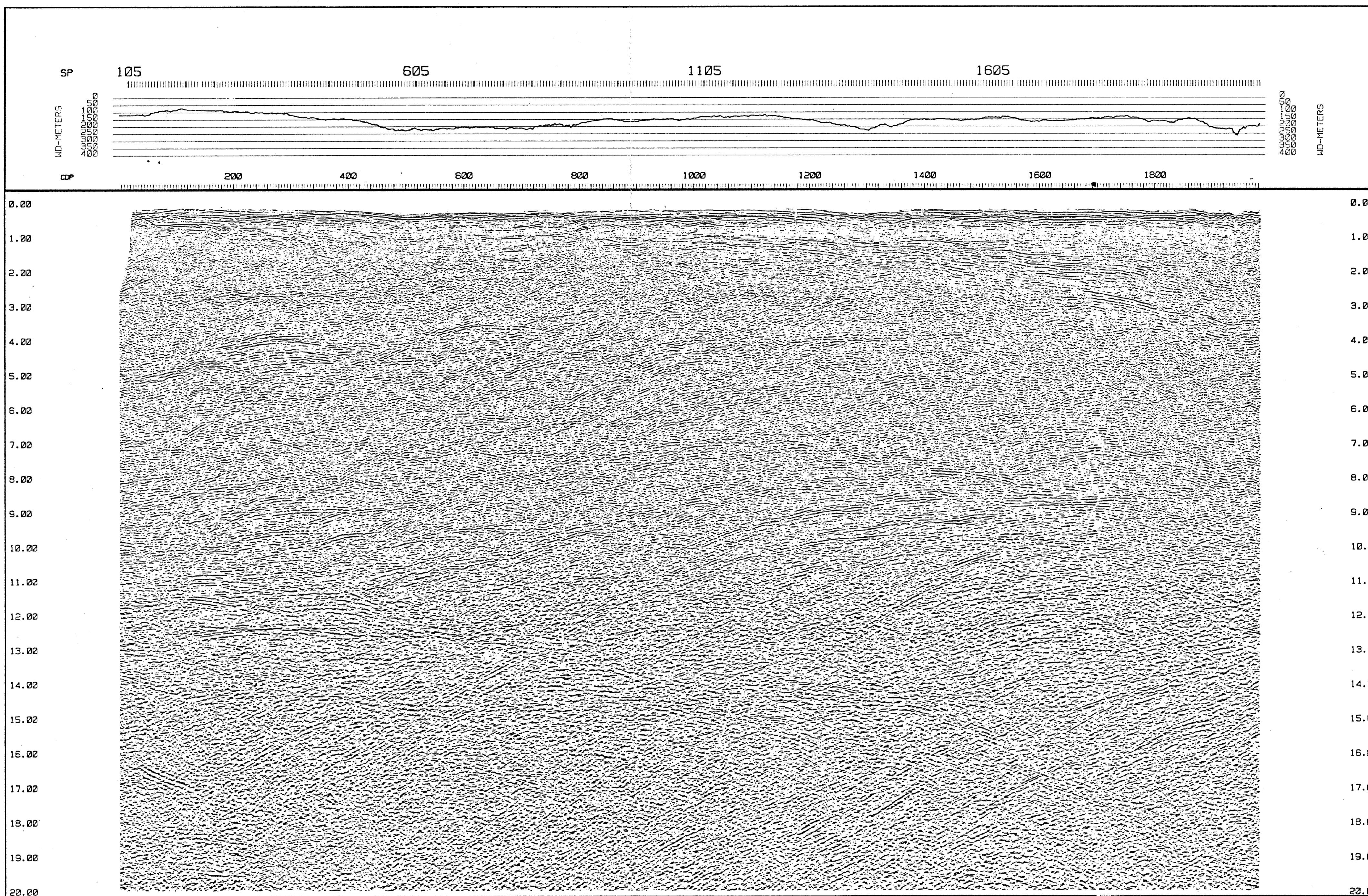
PROCESSED BY: U.S.G.S.  
BRANCH OF PETROLEUM GEOLOGY  
GEOPHYSICS GROUP

RECORDING PARAMETERS

RECORDED BY: G.S.I. DATE RECORDED: 6/7-SEPT-1986  
RECORDED BY: MARSHAL J. RONICH SECONDARY NAVY: CAFIN C  
INSTRUMENT TYPE: GUN GEOPHYSICS RANGE: 2000 M  
NO. OF GUN ARRAYS: 2 SUB ARRAYS SAMPLE RATE: 8 METERS  
TOT. GUN VOL.: 7300 CUB. INCHES TYPE GATE: PPA  
TYPE: GUN GATE: 1000 M SOURCE INTERVAL: 1000 M  
NO. OF CHANNELS: 120 SECONDS POSITION: 1000 M  
RECORD DENSITY: 100 SECONDS GATE: 1000 M  
RECORD FILTER: LOCUT: 5.3 - 12 OCTAVE CABLE TYPE: 120' COLD  
LOCUT: 18.0 - 12 OCTAVE CABLE: 50' SWAR  
HIGHCUT: 64 HZ POSITION: 1000 M  
LOWCUT: 32 HZ NEAR TRIG: 1000 M  
68 HZ NOTCH: CUT: 30 FOLD: 30  
SPREAD CONFIGURATION:  
TR 1 TR 120 SOURCE SHIP ANTENNA  
2975 M <- 296 M > -> 73 M

PROCESSING SEQUENCE

1 DEMULTIPLEX  
2 RECORDING GAIN REMOVAL  
3 GEOMETRY DEFINITION  
4 TRACE EDITING  
5 RESAMPLE TO 8.0 MS  
6 F-K FILTERING IN SHOT DOMAIN  
RANGE: 4 - 45 Hz  
FILTER LENGTH: 31 POINTS  
FILTER WIDTH: 13 TRACES  
MOVEOUT RANGE: +/- 5 ms/trace  
7 CDP (FOLD: 30)  
8.18 AUTOMATIC GAIN CONTROL  
GATE LENGTH: 1000 ms  
9.11 VELOCITY ANALYSIS  
10 PRELIMINARY STACK  
11 MULTI-TRACE SUPPRESSION IN CDP DOMAIN  
CORR. VEL: 1720 m/s  
APPL. GATE: 322 - 5322 ms  
12 NORMAL MOVEOUT CORRECTION  
13 FIRST BREAK NOISE SUPPRESSION (NUTE)  
14 FK-CROSS DECONVOLUTION  
15 SPIKING  
TYPE: SPIKING  
OPERATOR LENGTH: 59 POINTS  
TIME WINDOW: 0 - 4022  
TYPE: SPIKING  
OPERATOR LENGTH: 59 POINTS  
TIME WINDOW: 3022 - 5322  
TYPE: SPIKING  
OPERATOR LENGTH: 59 POINTS  
TIME WINDOW: 10222 - 20222  
16 STACK 3D FOLD  
17 BANDPASS FILTER  
TIME:  
0 - 2022 ms 4/8 - 32/36  
5222 - 6222 ms 4/8 - 23/31  
12222 - 22222 ms 3/5 - 25/32  
18 POST STACK DECONVOLUTION  
TYPE: 2ND ZERO CROSS  
OPERATOR LENGTH: 53 POINTS  
TIME WINDOW: 0 - 5322  
TYPE: 2ND ZERO CROSS  
OPERATOR LENGTH: 53 POINTS  
TIME WINDOW: 5222 - 20222  
20 VERTICAL SUM (4 TO 1)  
21 AUTOMATIC GAIN CONTROL  
GATE LENGTH: 2522 ms  
22 POST STACK AMPLITUDE MODULATION  
THREE-DIMENSIONAL SMOOTHING OVER  
3 TRACES HORIZONTALLY AND 3 SAMPLES  
VERTICALLY  
23 DISPLAY  
TRACES PER INCH: 100  
VERTICAL SCALE: .6 INCHES / SEC  
DISPLAY DATE: APRIL 4, 1988



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LAKE SUPERIOR  
LINE: C  
FINAL STACK

SOUTHEAST

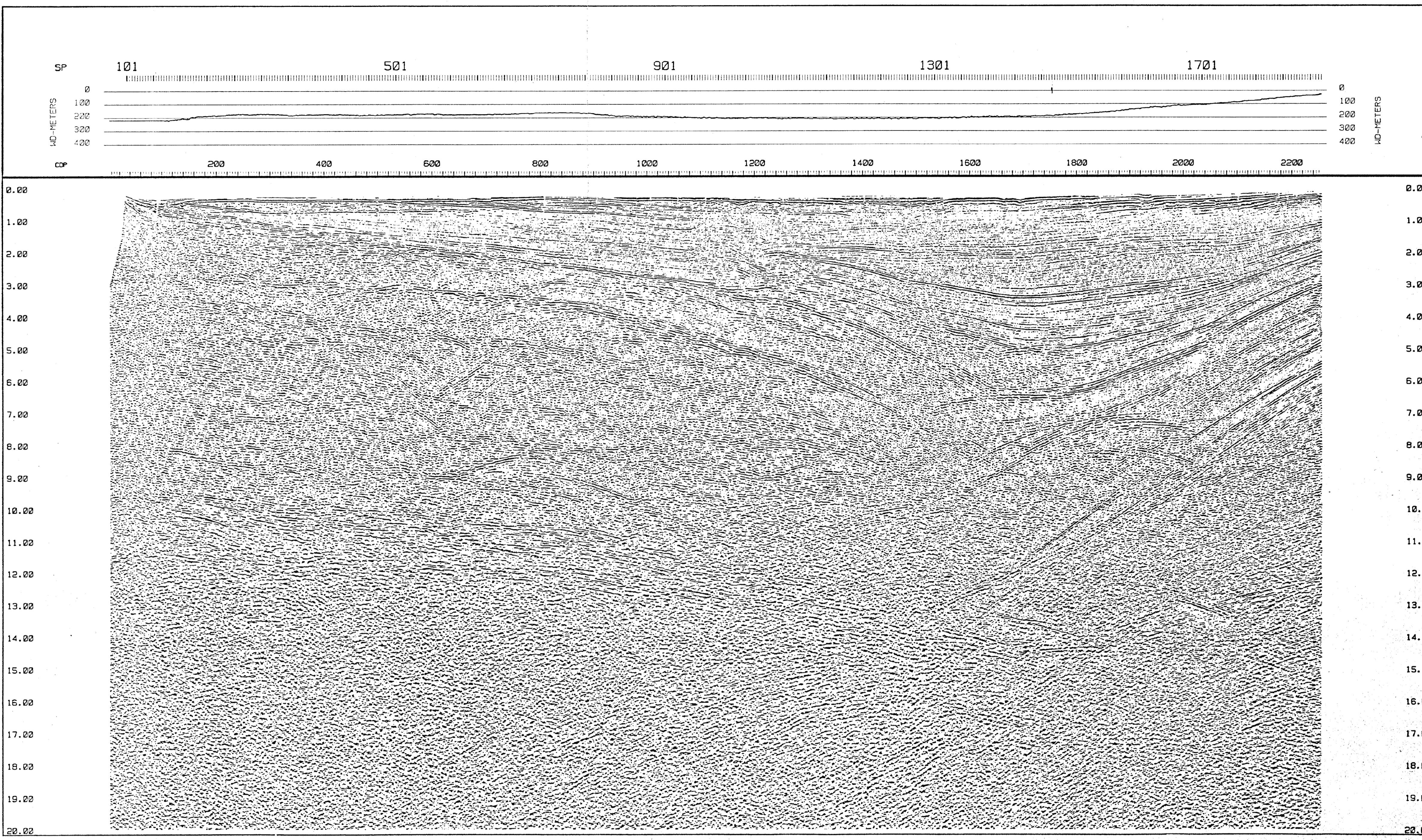
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GEOPHYSICS GROUP

#### RECORDING PARAMETERS

RECORDED BY:	FRED J. RICH	DATE RECORDED:	10/13 SEPT-1986
PRIMARY NAV. I:	GEOPHYSICS	SECONDARY NAV. I:	LORRAINE E.
INSTRUMENT TYPE:	GEOPHYSICS	SAMPLE RATE:	4.0 KHZ
ARRAY ARRAYS:	1	DEPTH OF RECORDING:	4.0 METERS
ARRAY WIDTH:	80 METERS	# OF GUNS:	62
DATA FORMAT:	SEGY-1980 SP1	FIRST DELAY:	5.12 MS
RECORD LENGTH:	20 SECONDS	CABLE LENGTH:	2000 METERS
RECORD FILTERS:	5.3 HZ	CABLE TYPE:	1207 COLD
SLOPES:	18 DEG/OCTAVE	LINER STARTS AT:	5.12 MS
HIGHLIGHT:	6.0 DEG/OCTAVE	NEAR TRACE #1:	100
60 Hz NOTCH:	CL	FOLD:	24
SPREAD CONFIGURATION:			
TR 1	TR 100	SOURCE	SHIP ANTENNA
--- 2975 M ---			
--- 231 M ---			
--- 181 M ---			
--- 771 M ---			
--- 772 M ---			
--- 1800 M ---			
--- 78 M ---			

#### PROCESSING SEQUENCE

1. DEMULTIPLEX
2. RECORDING GAIN REMOVAL
3. GEOMETRY DEFINITION
4. TRACE EDITING
5. RESAMPLE TO 8.0 MS
6. FK FILTERING IN SHOT DOMAIN
7. RAYLEIGH FILTERING: 4 - 45 HZ
8. FILTER LENGTH: 31 POINTS
9. FILTER WIDTH: 13 TRACES
10. MOVEOUT RANGE: +/- 5 MS/TRACE
11. CCP SORT: 24 FOLD
12. AUTOMATIC GATE CONTROL: GATE LENGTH: 1020 MS
13. VELOCITY ANALYSIS
14. PRELIMINARY STACK
15. MULTIPLEX SUPPRESSION IN CCP DOMAIN
16. CORR. VEL.: 1720 MS
17. APP. VEL.: 300 - 3222 MS
18. NORMA MOVEOUT CORRECTION
19. FIRST BREAK NOISE SUPPRESSION (MUTE)
20. PRE-STACK DECONVOLUTION
21. TYPE: SPIKING
22. OPERATOR LENGTH: 53 POINTS
23. TIME WINDOW: 0 - 4022
24. TYPE: SPIKING
25. OPERATOR LENGTH: 53 POINTS
26. TIME WINDOW: 3220 - 12022
27. TYPE: SPIKING
28. OPERATOR LENGTH: 53 POINTS
29. TIME WINDOW: 16202 - 22202
30. STACK 24 FOLD
31. BANDPASS FILTER
32. TIME: BANDPASS:
33. 0 - 2022 MS: 4/6 - 32/36
34. 5202 - 8232 MS: 4/8 - 28/31
35. 12232 - 22222 MS: 3/5 - 25/32
36. POST-STACK DECONVOLUTION
37. TYPE: 2ND ZERO CROSS.
38. OPERATOR LENGTH: 53 POINTS
39. TIME WINDOW: 0 - 5232
40. TYPE: 2ND ZERO CROSS.
41. OPERATOR LENGTH: 53 POINTS
42. TIME WINDOW: 6222 - 20222
43. VERTICES SUM (4 TO 1)
44. AUTOMATIC GATE CONTROL: GATE LENGTH: 2522 MS
45. POST-STACK AMPLITUDE MODULATION
46. TWO-DIMENSIONAL SMOOTHING OVER 3 TRACES HORIZONTALLY AND 3 SAMPLES VERTICALLY
47. DISPLAY
48. TRACES PER INCH: 102
49. VERTICAL SCALE: .5 INCHES / SEC
50. DISPLAY DATE: APRIL 4, 1988



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LAKE SUPERIOR  
LINE: F  
FINAL STACK

## SOUTHWEST

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GEOPHYSICS GROUP

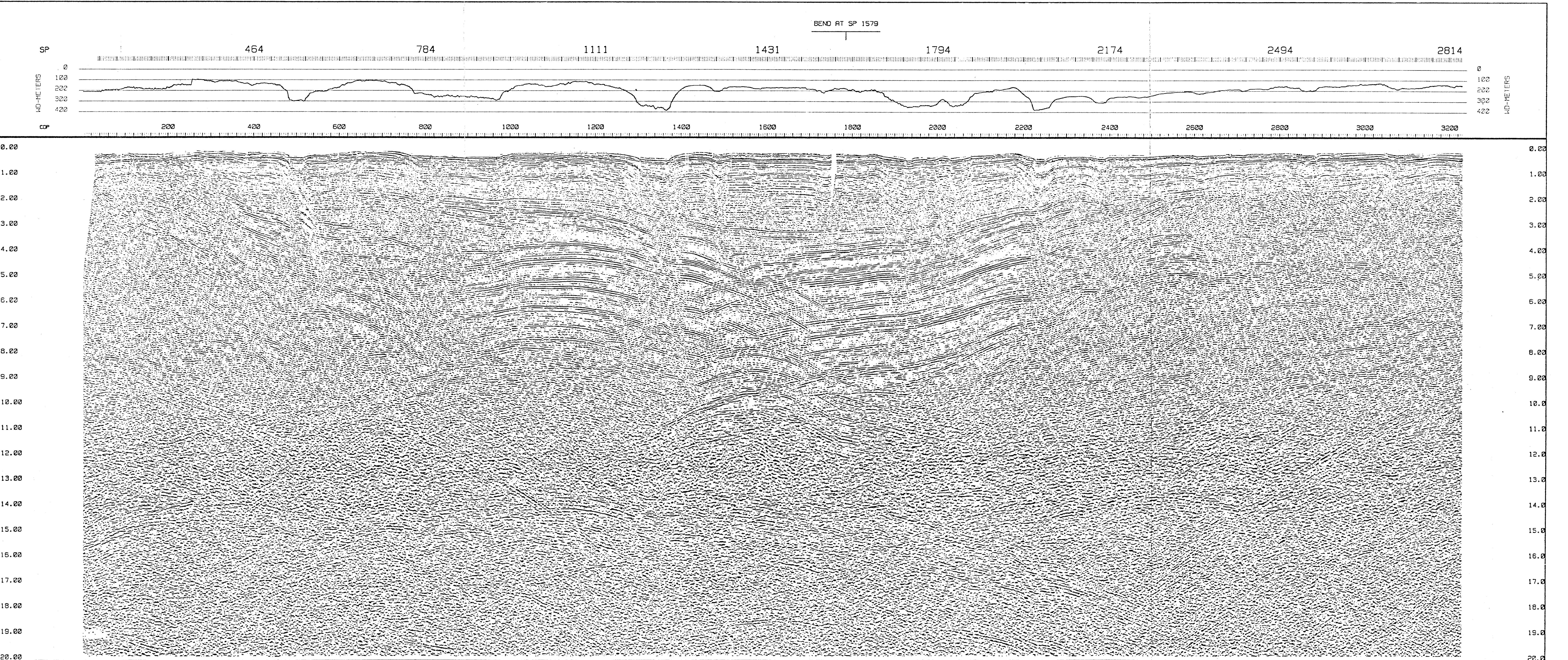
## RECORDING PARAMETERS

POED BY:	G.S.I.	DATE RECORDED:	7/16/SEPT-1986
ELT	MFM FRED J. RONICH	PARTY #:	2635
PAT NAV.:	GEORGE	SECONDARY NAV.:	JOHN C.
UMENT TYPE:	SAT/SOLAR/GYRO	SAMPLE RATE:	4.0 MS
GUN PARCTS:	DPS-V	GUN OPERATING DEPTH:	2 METERS
WIDTH:	E SLR ARRAYS	# OF GUNS:	62
GUN VOL.:	6 PETERS	TYPE GAIN:	PGC
FORMAT:	1/4" CQ. INCHES	FIRING DELAY:	51.2 MS
OF CHANNELS:	SEG-B 1600 BPI		
	122		

SOURCE INTERVAL:  
 59.8 M FOR SHOTPOINTS 121 - 456      68.5 M FOR SHOTPOINTS 457 - 886  
 59.8 M FOR SHOTPOINTS 887 - 902      68.5 M FOR SHOTPOINTS 922 - 1579  
 59.8 M FOR SHOTPOINTS 1580 - 2096      68.5 M FOR SHOTPOINTS 2097 - 2843  
 PG LENGTH: 20 SECONDS      TRACE INTERVAL: 26.0 METERS  
 PG FILTER:  
 LOCUT: 5.3 Hz, CABLE TYPE: 1200 COIL  
 SLOPE: 16.29 OCTAVE POSITIONING: 547-1579  
 HIGHCUT: 64 Hz, LINE STARTS AT: 1579-1580  
 SLOPE: 72.08 OCTAVE NEAR TRACE #: 122  
 Z NOTCH: OUT FOLD:  
 32 FOR SHOTPOINTS 121 - 456      24 FOR SHOTPOINTS 457 - 886  
 32 FOR SHOTPOINTS 887 - 902      24 FOR SHOTPOINTS 922 - 1579  
 30 FOR SHOTPOINTS 1580 - 2096      24 FOR SHOTPOINTS 2097 - 2843  
 SPREAD CONFIGURATION:  
 TR 120      SOURCE \*      SHIP ANTENNA O  
 2975 M → ← 228 M →  
 (SP 121 - 1579)  
 ← 232.5 M →  
 (SP 1582 - 2843)  
 ← 232.5 M →

## PROCESSING SEQUENCE

1 DEMULTIPLEX  
 2 RECORDING GAIN REMOVAL  
 3 GEOMETRY DEFINITION  
 4 TRACE EDITING  
 5 RESAMPLE TO 8.2 MS  
 6 F-K FILTERING IN SHOT DOMAIN  
     RANGE:                  4 - 45 Hz  
     FILTER LENGTH:         31 POINTS  
     FILTER WIDTH:         13 TRACES  
     MOVEOUT RANGE:         +/- 5 ms/TRACE  
 7 CDP SORT 32 & 24 FOLD  
     ( SEE "RECORDING PARAMETERS" ABOVE )  
 8.18 AUTOMATIC GAIN CONTROL  
     GATE LENGTH:         1000 ms  
 9.11 VELOCITY ANALYSIS  
 10 PRELIMINARY STACK  
 12 MULTIPLE SUPPRESSION IN CDP DOMAIN  
     CORR. VEL.:           1700 m/s  
     APPL. GATE:           300 - 5000 ms  
 13 NORMAL MOVEOUT CORRECTION  
 14 FIRST BREAK NOISE SUPPRESSION (MUTE)  
 15 PRE-STACK DECONVOLUTION  
     TYPE:                 SPIKING  
 16 STACK 32 & 24 FOLD  
     ( SEE "RECORDING PARAMETERS" ABOVE )  
 17 BANDPASS FILTER  
     TIME:                 BANDPASS:  
     -----  
     0 - 2200 ms           4/8 - 30/38  
     5000 - 8200 ms       4/8 - 28/31  
     12000 - 22000 ms     3/5 - 25/30  
 18 POST-STACK DECONVOLUTION  
     TYPE:                 2ND ZERO CROSS.  
 20 VERTICAL SUM (4 TO 1)  
 21 AUTOMATIC GAIN CONTROL  
     GATE LENGTH:         2500 ms  
 22 POST STACK AMPLITUDE MODULATION  
     TWO-DIMENSIONAL SMOOTHING OVER  
     3 TRACES HORIZONTALLY AND 3 SAMPLES  
     VERTICALLY  
 23 DISPLAY  
     TRACES PER INCH:     102  
     VERTICAL SCALE:       .6 INCHES / SEC  
     DISPLAY DATE:         APRIL 4, 1988



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LAKE SUPERIOR  
LINE: G  
FINAL STACK

SOUTHEAST

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RECORDING PARAMETERS

RECORDED BY: G.S.T. DATE RECORDED: 11-SEPT-1986  
VESSEL: M.V. FRED J. RONICH PARTY #: 2205  
PRIMARY NAV.: G.P.S./SONAR/GYRO SECONDARY NAV.: DOPPLER  
INSTRUMENT TYPE: DOPPLER ARRAYS SPINNING RATE: 4.0 Hz  
ARRAY WIDTH: 90 METERS SPINNING DEPTH: 6 METERS  
TOTAL LENGTH: 100 METERS # OF GUNS: 80  
TAPE FORMAT: SEB 1300 BPI FIRING RAY: P  
NO. OF CHANNELS: 128 SOURCE INTERVAL: 0.625 m  
RECORD INTERVAL: 128 SECONDS TRACE INTERVAL: 0.625 m  
RECORD FILTER: LOCUT: S-3 Hz  
DOL: 1200 ms COLD  
SLOPE: 18 DEG/CTAVE LINE LENGTH: 1220  
HIGH: 64 ms LINE STARTS AT: SOUTHEAST  
SLOPE: 72 DEG/CTAVE NEAR TRACE #: 122  
60 Hz NOTCH: OUT FOLD: 24

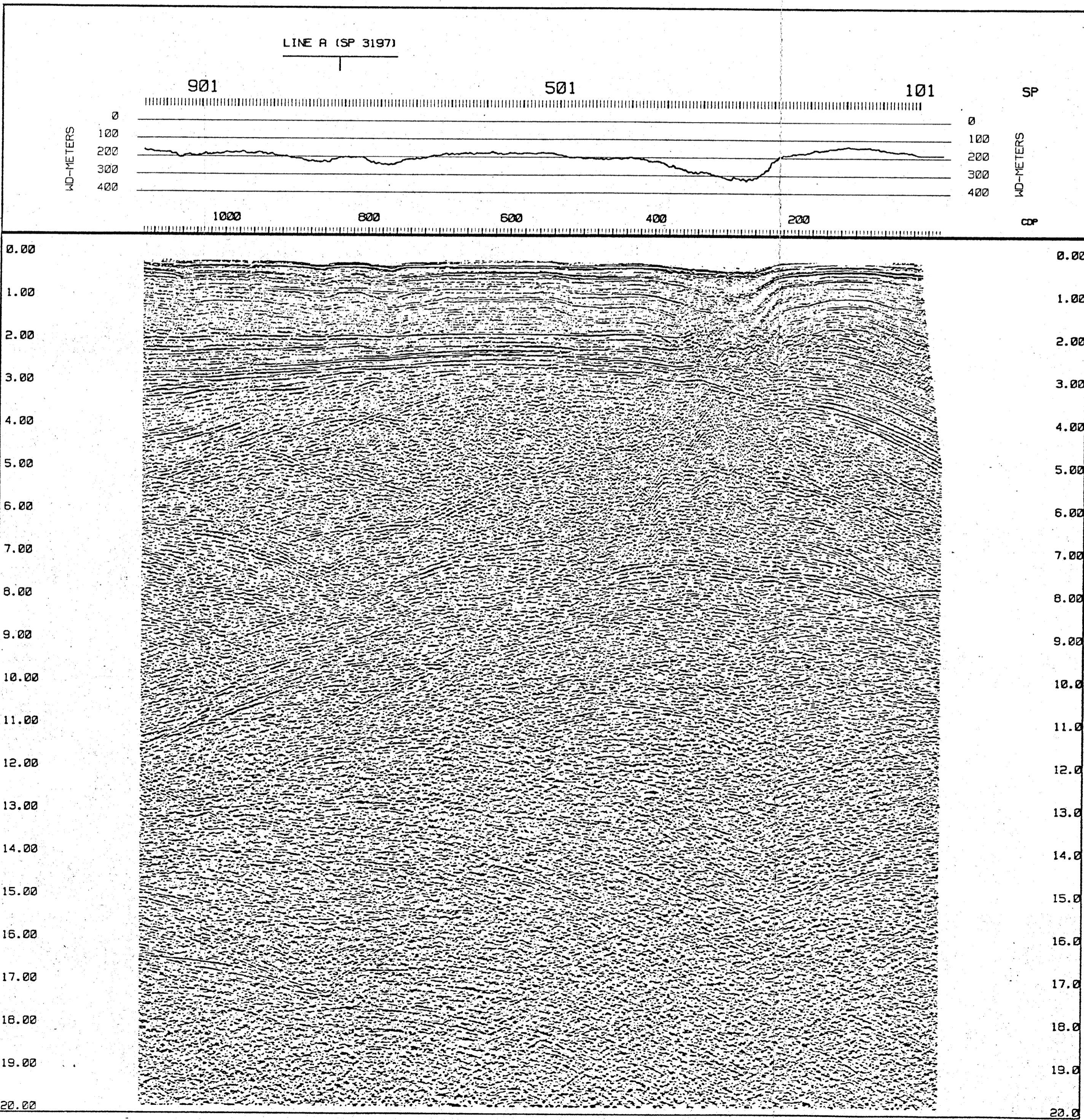
SPREAD CONFIGURATION:  
TR 1 TR 128 SOURCE SHIP ANTENNA  
2975 M <- 232 M -> 73 M ->

PROCESSING SEQUENCE

1 DEMULTIPLEX  
2 RECORDING GAIN REMOVAL  
3 GEOMETRY DEFINITION  
4 TRACE EDITING  
5 RESAMPLE TO 8.0 MS  
6 F-K FILTERING IN SHOT DOMAIN  
7 F-K FILTER LENGTH: 4 - 45 Hz  
8 FILTER LENGTH: 31 POINTS  
9 FILTER WIDTH: 13 TRACES  
10 MOVEOUT RANGE: +/- 5 ms/TRACE  
11 CDP SORT 24 FOLD  
12 AUTOMATIC GAIN CONTROL  
13 GATE LENGTH: 1020 ms  
14 VELOCITY ANALYSIS  
15 PRELIMINARY STACK  
16 MULTIPLE SUPPRESSION IN CDP DOMAIN  
17 CORR. VEL.: 1700 m/s  
18 APP. GATE: 300 - 2000 ms  
19 NORMAL MOVEOUT CORRECTION  
20 FIRST BREAK NOISE SUPPRESSION (MUTE)  
21 PRE-STACK DECONVOLUTION  
22 TYPE: SPIKING  
23 OPERATOR LENGTH: 69 POINTS  
24 TIME WINDOW: 0 - 4000  
25 TYPE: SPIKING  
26 OPERATOR LENGTH: 69 POINTS  
27 TIME WINDOW: 3200 - 12000  
28 TYPE: SPIKING  
29 OPERATOR LENGTH: 69 POINTS  
30 TIME WINDOW: 10200 - 20200  
31 STACK 24 FOLD  
32 BANDPASS FILTER  
33 TIME: BANDPASS:  
34 0 - 2000 ms 4/8 - 32/35  
35 5000 - 8000 ms 4/8 - 28/31  
36 12000 - 22000 ms 5/5 - 25/30  
37 POST-STACK DECONVOLUTION  
38 TYPE: 2-D ZERO CROSS.  
39 OPERATOR LENGTH: 69 POINTS  
40 TIME WINDOW: Z - 5022  
41 TYPE: 2-D ZERO CROSS.  
42 OPERATOR LENGTH: 69 POINTS  
43 TIME WINDOW: 5222 - 22200  
44 VERTICAL SUM (4 TO 1)  
45 AUTOMATIC GAIN CONTROL  
46 GATE LENGTH: 2520 ms  
47 POST STACK AMPLITUDE MODULATION  
48 TWO-DIMENSIONAL SMOOTHING OVER  
49 3 TRACES HORIZONTALLY AND 3 SAMPLES  
50 VERTICALLY  
51 DISPLAY  
52 TRACES PER INCH: 100  
53 VERTICAL SCALE: 16 INCHES / SEC  
54 DISPLAY DATE: FEBRUARY 10, 1986

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PLATE 5





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PLATE 7

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## RECORDING PARAMETERS

RECORDED BY:	G.S.I.	DATE RECORDED:	20/21-SEPT-1986
VESSEL:	M/V FRED J. AGNICH	PARTY #:	2225
PRIMARY NAV.:	GEOMAR	SECONDARY NAV.:	LORAN C
INSTRUMENT TYPE:	SAT/SOMAR/GYRO	SAMPLE RATE:	PARADE/RANGE
# OF GUN ARRAYS:	DCS-V	GUN OPERATING DEPTH:	4.2 MTS
ARRAY WIDTH:	6 SUB ARRAYS	# OF GUNS:	5 METERS
TOT. GUN VOL.: INCHES	202 METERS	TYPE GAIN:	PSO
TAPE FORMAT:	7762 CU. INCHES	FIRING DELAY:	5.0 MTS
NO. OF CHANNELS:	SEG-B 1602 BP	SOURCE INTERVAL:	100.0 METERS
RECORD LENGTH:	120	TRACE INTERVAL:	25.0 METERS
	SECONDS		
RECORD FILTER:		CABLE TYPE:	120' COIL
LOCUT:	5.3 Hz	POSITIONING:	SSDP/SDAF
SLOPE:	16 DB/OCTAVE	LINE STARTS AT:	SDP
HICUT:	64 Hz	NEAR TRACE #:	122
SLOPE:	72 DB/OCTAVE		
60 Hz NOTCH:	DET	FOLD:	24
SPREAD CONFIGURATION:			
TR 1	TR 120	SOURCE	SHIP ANTENNA
		*	
<- 2575 M ->		<- 232 M ->	TR M

## PROCESSING SEQUENCE

1 DEMULTIPLEX  
 2 RECORDING GAIN REMOVAL  
 3 GEOMETRY DEFINITION  
 4 TRACE EDITING  
 5 RESAMPLE TO 8.0 MS  
 6 F-K FILTERING IN SHOT DOMAIN  
     RANGE:                  4 - 45 Hz  
     FILTER LENGTH:         31 POINTS  
     FILTER WIDTH:         13 TRACES  
     MOVEOUT RANGE:         +/- 5 ms/TRACE  
 7 COP SORT 24 FOLD  
 8.18 AUTOMATIC GAIN CONTROL  
     GATE LENGTH:         1000 ms  
 9.11 VELOCITY PNPYSIS  
 10 PRELIMINARY STACK  
 12 MULTIPLE SUPPRESSION IN COP DOMAIN  
     CORR. VEL.:           1700 m/s  
     APPL. GATE:           300 - 3200 ms  
 13 NORMAL MOVEOUT CORRECTION  
 14 FIRST BREAK NOISE SUPPRESSION (MUTE)  
 15 PRE-STACK DECONVOLUTION  
     TYPE:                  SPIKING  
     OPERATOR LENGTH:     59 POINTS  
     TIME WINDOW:           0 - 4222  
     TYPE:                  SPIKING  
     OPERATOR LENGTH:     59 POINTS  
     TIME WINDOW:           3000 - 12222  
     TYPE:                  SPIKING  
     OPERATOR LENGTH:     59 POINTS  
     TIME WINDOW:           10000 - 20222  
 16 STACK 24 FOLD  
 17 BANDPASS FILTER  
     TIME:                  BANDPASS:  
     -----  
     0 - 2022 ms           4/8 - 32/36  
     5000 - 8300 ms       4/8 - 28/31  
     12000 - 22200 ms     3/5 - 25/32  
 18 POST-STACK DECONVOLUTION  
     TYPE:                  2ND ZERO CROSS.  
     OPERATOR LENGTH:     53 POINTS  
     TIME WINDOW:           0 - 5022  
     TYPE:                  2ND ZERO CROSS.  
     OPERATOR LENGTH:     53 POINTS  
     TIME WINDOW:           5022 - 22222  
 20 VERTICAL SUM (4 TO 1)  
 21 AUTOMATIC GAIN CONTROL  
     GATE LENGTH:         2500 ms  
 22 POST STACK AMPLITUDE MODULATION,  
     TWO-DIMENSIONAL SMOOTHING OVER  
     3 TRACES HORIZONTALLY AND 3 SAMPLES  
     VERTICALLY  
 23 DISPLAY  
     TRACES PER INCH:     102  
     VERTICAL SCALE:       .6 INCHES / SEC  
     DISPLAY DATE:          APRIL 4, 1988

